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ABSTRACT

Policy Analysis and Simulation System (PASS) is an interactive microcomputer model that can be used by educational administrators, policy-makers, and planners to simulate and forecast, under conditions of environmental uncertainty, the impact of strategic policies on the projected trends and goals of educational performance. PASS generates alternative futures by incorporating various analytic procedures with the subjective judgments of experts to produce a single possible scenario that compares a simulated future with three alternative forecasts for the same period. PASS is a menu-driven program that operates on an Apple IIe microcomputer with a single disk drive and a printer. A graphic display of the program and 12 references are appended. (MLF)

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Policy Analysis and Simulation System for Educational Institutions

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I Rationale

Fducational Organizations are perceived as social systems existing in and interacting with their environment. All organizations are social systems with some degree of openness (Gibson 1968). That is, there is a degree of exchange of information between the organization and the larger social system environment. Changes in the environment can and often do have consequential effects on an organization.

In contemporay American society, the environment has become increasingly turbulent with the rate and magnitude of change accelerating. Given this rapidly changing environment in which schools find themselves, today's educational administrators are confronted with a degree of uncertainty heretofore of little concern. One of the contemporary critical issues administrators must address is determining the way in which they must analyze and implement strategic policies necessary for their organizations to cope with all aspects of education's environment. Concurrently, the lead time administrators have to analyze and formulate strategic policies which address the impact of environmental changes on the various sub-system or components of the educational system has decreased. More significant, the policy-making process of educational administrators is pervaded by an aura of uncertainty that narrows the context of the policy interventions being considered and that intensifies the perceived risk of implementing a particular set of policies.

One of the primary functions of all strategic policy planning, including that in the field of education, is the identification and development of alternative images of the future depicting the long-term change affecting the educational enterprise. Well developed scenarios of alternative futures provide the basis for selecting the strategic posture that may otherwise be difficult to identify in

a rapidly changing environment. When the pace of change quickens, the impacts that result are rapidly transmitted from one environmental sector to another in a type of domino effect leading to further changes. When perceived by the policy-maker and educational planner, such an environment is often viewed as an arena of unchartable change that offers few signs to guide policy selection and decision-making.

In recent years, strategic planners have developed a heightened appreciation of the uncertainty of change and the ambiguity in a system's environment. The effects of the general societal environment on the tasks of the organization is well documented in the literature of organizational analysis (Hall, 1972; Osborne & Hunt, 1974); but current contingency approaches to organzational theory have increasingly focused the attention of organizational analysts upon the role of environmental uncertainty and its perception by policy-makers in the formulation of an organization's strategic plans. (Anderson & Paine, 1975; Lindsay & Rue, 1980; Boulton, Lindsay, Franklin & Rue, 1982). Buncan (1972) describes three aspects of an administrator's perception of the environment that would indicate uncertainty and hamper his or her ability to formulate organizational strategy: (1) a lack of information about which environmental factors would influence a given decision-making situation, (2) a lack of knowledge about the effects of an incorrect decision, and (3) the inability of the decision-maker to determine the probability that a given environmental factor will affect the success (or failure) of the organization or one of its subsystems in fulfilling its mission. In a later study, Leblibici and Salancik (1981) suggested that the uncertainty experienced by a decision-maker arises from his or her inability to predict the outcomes of some action taken by the decision-maker to achieve them. This inability to predict decision outcomes is derived from two sources

of uncertainty. The first is the decisions-makers lack of knowledge to infer cause-effect relationships and the second is the probabilistic conditions of the environment within which the outcomes are to occur. In essence, the more one is able to anticipate the probability of a decision's outcome, the less the uncertainty posed by the environment.

The uncertainty faced by a decision-maker in planning strategically is not only compounded by environmental change, but by the impact of human interventions in the form of policies introduced by the planner herself (or some other policy source) which is inherently unpredicatable and further adds to environmental uncertainty. The policy responses of social institutions to evolving conditions are essential factors in shaping the educational environment. However, the possibility of such responses only creates an additional set of uncertainties that the prospective decision-maker must deal with in his or her attempt to structure an image of the environment's dynamics necessary to identify feasible alternative strategies and policies.

Thus, it is reasonable to conclude that the strategic planner and policy-maker can not examine the condition of the environment as it may exist in the future by assuming that it will be in a static state. An environment's future is dynamic in its evolution over time and consequently, rich in possible opportunities and possible threats to the organization. Knowledge of the large number of environmental changes brought about by possible combinations and permutations of environmental developments denies the planner the certitude about the future state of the environment. The planner or decision-maker will never have the complete information of the future by which to test and evaluate his or her policies and plans. Decisions regarding the selection of policy made in the present with the intent of affecting some form

of desired outcome at a future point in time, must necessarily be made with incomplete information or, at best, partial information.

In recent years, a group of techniques have been developed which the educational policy-maker can employ in establishing the strategic policy of his or her organization. These techniques come under a broad category of methodology known as futures research. A primary purpose of this methodology is to assist strategic policy planners in reducing the level of uncertainty associated with strategic decision-making and, at the very least, provide them with a rational and systematic approach to the development, analysis and evaluation of those strategies intended to bring about possible future conditions beneficial to the organization.

Futures research has attempted to assist strategic planners by developing methodologies that facilitate the identification, analysis and evaluation of alternative future states of a system's environment and the sources of change within it. These approaches have traditionally included scenario writing, Delphi and cross-impact analyses. However, these methods are notably weak in the following respects: (1) It is difficult to relate the results obtained from these approaches to the indicators of organizational performance used by policy-makers as criteria for evaluating alternative policies in order to assess the consequences of dealing explicity with the uncertainty of environmental developments in terms that are relevant to the organization. (2) More importantly, these methods of futures research do not permit the planner to explore the implications of environmental change that results when human interventions in the form of policies are introduced into the milieu of the future.

One potentially useful way to explore the implications of alternative

strategic policies requires the use of an interactive simulation approach. This approach is a form of forecasting which combines the judgements of human deliberation with the analytic models of more conventional forecasting methodologies for the purpose of showing changes in the state of the system through time. Fiksel (1980) describes such approaches as "metamodeling" because they integrate both mathematical and subjective models into a model that gives the analysts the capability to understand and forecast the behavior of complex systems. Such models are inherently probabilistic in that they contain sudden changes that may occur in the system's environment in the future which, were they to occur, would affect the projections of trends endogenous to the organizational system. These changes are described probabilistically and have an unpredicatable randomness supplied by a random number generator.

II The Policy Analysis and Simulation Model

This paper describes a futures research methodology that can be used as a planning support tool, Policy Analysis and Simulation System (PASS). It is an interactive microcomputer model that can be used by educational administrators, policy-makers, and planners to simulate and forecast under conditions of environmental uncertainty, the impact of strategic policies on the projected trends and goals of educational performance. Although forecasting tools have been used in educational management for sometime, simulation and modeling techniques have only recently been employed on a limited basis. PASS was developed to assist decision-makers in enhancing the probability of implementing strategic policies that will keep an educational institution viable in an uncertain future by ascertaining those potential

policies that will best achieve the goals of the institution under conditions of environmental uncertainty. The model employed is derived from the work of both William Renfro (1980) in policy impact analysis as a generic futures research methodology and James L. Morrison's (1981) application of the policy impact analysis model to instututional research and the development of public education policy.

PASS generates alternative futures by incorporating various analytic procedures with the subjective judgements of experts to produce a single possible scenario which compares a simulated future with three alternative forecasts for the same time period. These forecasts, are of the "surprise-free" future, the "desired" future, and the "expected" future.

The framework of the model is one of iterative refinement of the probabilities of certain specified future events occurring and impacting the projected trends of three variables endogenous to the organization. This is accomplished by having the analysts devise policies that affect in some degree the probability and impact of these future events. The analytic model begins with the data of three trends extrapolated into the future for some period designated by the analysts. Three additional sets of variables are then incorporated into the model so as to simulate a future relevant to the analyst or planning group. These additional factors, possible future events, goals, and policies then interact with the basic trend data to simulate a forecast of a future intended to be acceptable to the organizational analyst or planning group.

Each of these factors have been combined into a probabilistic mathematical model and incorporated into a set of computer programs. The computer programs do not remove the ability from the analysts to interject subjective decision-making judgements based upon their expertise into the model. Rather the programs do the calculations and display the results so

that the future effects of policies considered can be simulated. This is done by providing the analysts with a detailed record of each judgemental decision made on the probabilities of future events occuring, their impact on the trend data, and the extent that possible policies impact both events and trends. Since the computer program can proceed through the analysis quite rapidly, numerous interations using "what if" variations on the original estimates of the effect of policies can be examined under various scenarios combining different events.

Historic data on a trend must be obtained as the starting point for using PASS. From the trend data an extrapolated forecast of each of the three trends is made into the future for up to twenty years. A regression technique is employed to develop this forecast as a time-series. It is conceived of as a type of "future-from-the-past" forecast depicting a "surprise'free" scenario for the future. The next phase of the model requires the analysts to select from one to thirty events that they believe have some probability of occurring in the future and, were they to occur, would have an impact on the trends previously projected. The probability of each event is also identified along with a numerical value representing the event's impact on each trend. The output of this phase is another forecast showing new values of each trend for each future year as the trends are impacted by each event and by all events taken together as a future scenario. This forecast represent the future that could "happen to" the organization and depicts the "expected" scenario. The mathematical model used in this portion of the program is based upon the computational scheme developed by Alter (1976).

The third scenario produced by the model is the organization's "desired" future. To produce this future, the analyst inputs into the model the value

or "goal" she/he believes should represent the trends during each year of the forecast. These values become bench marks against which the analysts can judge the appropriateness of the proposed policies under consideration for implementation, to bring about change to the direction of the trends from those depicted in the "expected" scenario to those represented by the desired future.

PASS requires the analysts to assess the probabilities of each event identified in phase two of the model in the light of the occurrence of every other event. This is done using the technique of cross impact analysis which ensures that the model takes into account the fact that the occurrence of an event may increase (or decrease) the probability that other events occur.

The final phase of PASS is the actual simulation. During this phase the analysts have the opportunity to intervene into the expected future by introducing policies that can either enhance or inhibit the impact of the future events on the trend indicator. The model is programmed so that events either occur randomly (computer/random generated mode) or can be orchestrated in different sequences by the analysts (interactive mode). The simulation can be repeated as many time as the analyst wishes allowing him/her to study different simulated scenarios and the resulting impact of the policies selected. The computer random generated mode produces data showing the robustness of policy decisions or trend values by developing fifty simulated futures. In the interactive mode, the analysts can respond to events as they occur by having the opportunity to implement proposed policies for any interval within the time span set for the forecast.

The model provides a record of the extrapolated data of the trend variables chosen for their importance to the organization. The "future events" are recorded along with their estimated probability of occurrence and

the year in which they will occur. A cross impact assessment of each event with all others is recorded to display the degree of interrelatedness of the future events. The resultant scenarios are displayed, indicating the effect of each policy on the trend variable(s).

PASS is programmed to operate on an Apple IIe microcomputer with a single disk drive and a printer. The program is written in the Assembler language and is menu-driven. The main menu presents the nine major areas of the PASS system for selection by the program user. The menu's selections are highlighted in sequence and allows entry and re-entry as often as needed into the major divisions of the system with most screens having a prompting menu visable.

A PASS model can be saved by name for later use. When models are loaded from the disk, the system acts as if information has been typed in from the keyboard. Another feature of PASS is the ease of entering and editing information. All output is in a tabular or graphical form. A user viewing output on the monitor also has the option to have it displayed in printed hard copy form.

III Benefits of PASS

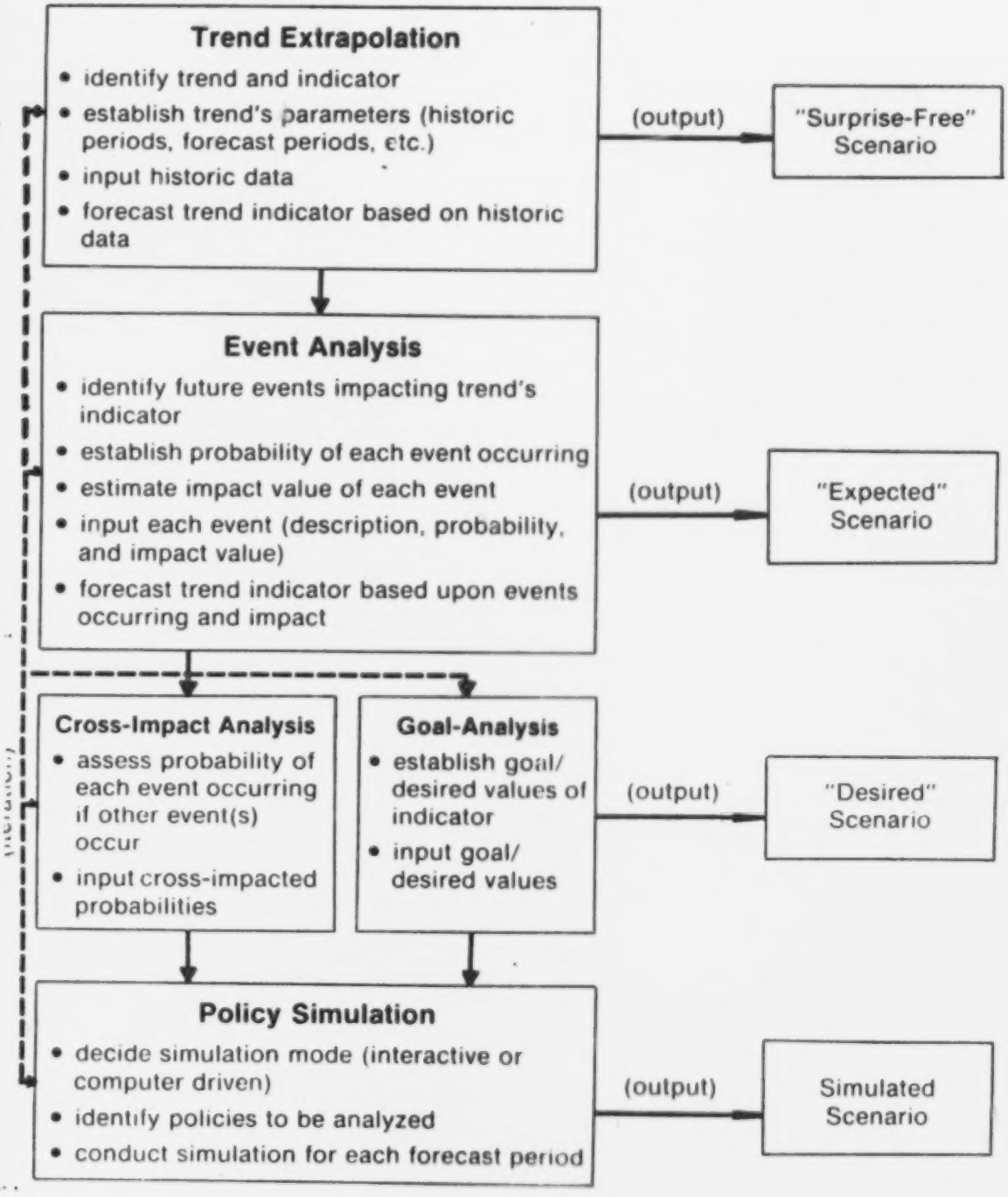
Significant benefits can accrue to an educational agency that utilizes PASS in its strategic planning. The ability to explore a series of alternate futures that incorporate a wide range of possible future events and the institutional consequences of policies can improve the selections of strategic objectives. Without the computerization of the policy impact model, it would be extremely difficult to manipulate large numbers of variables simultaneously. The computerized system relieves the analysts of all computational tasks except that of exercising their subjective judgements

about what policies may be appropriate under differing environmental circumstances in the future. Most organizational planning has looked at policy implementation serially, one policy at a time, rather that as clusters of policies that could (or could not) complement one another. PASS allows the planner to evaluate the impact of alternative scenarios on organizational trends that are important to the organization's continued survival.

Preliminary pilot testing of PASS with a small number of public agency adminstrators, including educators indicated that the model is easy to learn to use. They also reported that the simulation of prospective policy implementation was a useful long range planning tool. Their evaluative comments lend support to the contention that an easy to use computer based simulation modeling tool can enhance the organization's capability to plan policies that have some degree of probability of enhancing the organization's goals.

PASS©

An interactive computer simulation for educational policy analysis


Trend Extrapolation
• identify trend and indicator
• establish trend's parameters (historic periods, forecast periods, etc.)
• input historic data
• forecast trend indicator based on historic data
(output)
"Surprise-Free" Scenario
Event Analysis
• identify future events impacting trend's indicator
• establish probability of each event occurring
• estimate impact value of each event
• input each event (description, probability, and impact value)
• forecast trend indicator based upon events occurring and impact
(output)
"Expected" Scenario
Cross-Impact Analysis
• assess probability of each event occurring if other event(s) occur
• input cross-impacted probabilities
Goal-Analysis
• establish goal/ desired values of indicator
• input goal/ desired values
(output)
"Desired" Scenario
Policy Simulation
• decide simulation mode (interactive or computer driven)
• identify policies to be analyzed
• conduct simulation for each forecast period
(output)
Simulated Scenario

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REFERENCES

1. Alter, Steve The Computational Mathematics of Time-Dependent Cross Impact Modeling (Report M26) Los Angeles: University of Southern California, 1976.

2. Anderson, C.R. and Paine, F.T. "Managerial Perceptions and Strategic Behavior", Academy of Management Journal. 1975, Vol. 18, No. 4, pp. 811-823.

3. Boulton, W.R. Lindsay, W.M., Franklin, S.G., Rue, L.W. "Strategic Planning: Determining the Impact of Environmental Characteristics and Uncertainty", Academy of Management Journal. 1982, Vol. 25. No. 3, pp. 500-509.

4. Duncan, Robert B. "Characteristics of Organizational Environments and Perceival Environmental Uncertainty", Administrative Science Quarterly. 1972, Vol. 17, pp. 313-327.

5. Fiksel, Joseph "Computerizing the Crystal Ball: Towards a Meta Modeling Capability", Technology Forecasting and Social Change. 1980, Vol. 17, pp. 201-210.

6. Gibson, R Oliver. "A General Systems Approach to Decision-Making in Schools", The Journal of Educational Administration.1968, Vol. 6, No. 1, pp. 13-32.

7. Hall, Richard H. Organizations: Structure and Process. Englewood Cliffs: Prentice-Hall, Inc., 1972.

8. Leblebici, H. and Salancik, G.R. "Effects of Environmental Uncertainty on Information and Decision Process in Banks", Administrative Science Quarterly. 1981, Vol. 26, pp. 578-596.

9. Lindsay, W.M. and Rue, L.W. "Impact of the Organization Environment on the Long-Range Planning Process: A Contingency View", Academy of Management Journal. 1980, Vol. 23, No. 3, pp. 385-404.

10. Morrison, James L. Policy-Impact Analysis: Implications for Institutional Research. Paper presented at a joint conference of the Southern Association for Institutional Research and the North Carolina Association for Institutional Research, Charlotte, NC. October, 1981.

11. Osborn, R.N. and Hunt, J.G. "Environment and Organization Effectiveness, Administrative Science Quarterly. June 1974, pp. 231-246.

12. Renfro, William L. "Forecasting the Impact of Public Policies", Long Range Planning. 1980, Vol. 13, pp. 80-89.